Memorandum

U.S. Department
of Transportation

**Federal Aviation
Administration**

Subject: INFORMATION: SFAR 88 – Mandatory Action Decision Criteria

Date: February 25, 2003

From: Manager, Transport Standards Directorate, Aircraft Certification Service, ANM-100

Reply to Attn. of: *2003-112-15*

To: See Distribution

Regulatory Reference: SFAR 88

Summary/Background:
The purpose of this memorandum is to provide standardized policy for determining the need for mandatory action relative to the findings from the fuel system safety review required by Special Federal Aviation Regulation Number 88 (SFAR 88). SFAR 88 requires certain Type Certificate (TC) and Supplemental Type Certificate (STC) holders to conduct a system safety review of fuel tank systems on transport category airplanes using the provisions of 14 CFR 25.981 (a) and (b) (Amendment 25-102) and 25.901 and submit a report to the FAA. The compliance dates for TC holders and STC holders are December 6, 2002, and June 6, 2003, respectively. These reviews are a "re-evaluation" of previously approved fuel systems using the current ignition prevention standards (Amendment 25-102). Note that the SFAR 88 process is not a re-certification effort.

SFAR 88 is a process for determining what design and/or maintenance improvements would be required to bring each existing transport category airplane into compliance with 14 CFR 25.981 (a) and (b) (Amendment 25-102) and 25.901. Some of these improvements may warrant airworthiness directives implemented under Part 39, others may not. A "Spot Amendment" to SFAR 88, Amendment 21-82, was issued to add an equivalent safety finding provisions and clarify that fuel tank systems designs not meeting the new standards will be further reviewed under part 39, Airworthiness Directives, to determine if design changes or other action are required to resolve unsafe conditions. SFAR 88 was also revised to allow additional time for STC holders and operators to comply.

Recently several applicants have requested use of equivalent safety provision of the Spot amendment and have proposed use of inerting systems, or polyurethane foam in combination with certain design changes and maintenance actions to address ignition sources. These proposals have introduced the concept of flammability reduction as a factor in determining unsafe conditions on in-service airplanes. In order to determine which fuel tank system design feature will require mandatory action, the FAA has established a 4-element unsafe condition evaluation criteria that was presented in the November 19, 2002, Fuel Tank Safety Workshop held in Washington, D.C. This memorandum will expand on the guidance that was presented at that workshop. The

Federal Aviation Administration (FAA) and Joint Aviation Authorities (JAA) have developed this harmonized criteria for determination of an unsafe condition based upon the findings from the SFAR 88 fuel tank system safety review.

One of the elements used in this evaluation criteria involves a determination of whether the fuel tank is classified as having a relatively high flammability exposure time, or having a relatively low flammability exposure time. Except for the case where an ignition source is continuously present, a relatively low fuel vapor flammability exposure time substantially decreases the probability of tank explosions (low risk). While a higher flammability exposure time has been associated with higher risk, given a similar intermittent exposure to ignition sources. In general, unheated aluminum wing tanks and unheated center wing tanks fueled with Jet A have exhibited an acceptable level of safety. Wing and body tanks fueled with JP-4 (or a mixtures of Jet A and JP-4) and heated center wing tanks fueled with Jet A have not had an acceptable level of safety on many airplanes.

The consideration of flammability exposure time in the unsafe condition determination process is not intended to imply that ignition source prevention is unimportant for tanks with low flammability exposure time. The fundamental method for preventing fuel tank explosions involves establishing that the fuel tank system designs do not develop a condition that would result in an ignition within the fuel tank ullage space and fluid leakage zones (i.e. ignition prevention). Ignition prevention measures will still be the principle line of safety in the fuel tank system. However, the unsafe condition determination will take into consideration the tank flammability exposure time in determining the extent of ignition source reduction needed.

This memorandum provides guidance to be used for determining unsafe conditions, due to ignition sources, based upon results from the one time design reviews conducted to evaluate compliance with §§ 25.981 (a) and (b) (Amendment 25-102) and 25.901 in accordance with SFAR 88. The TC and STC holder's system safety assessment provided in their fuel tank system design reviews and flammability exposure time determination of each fuel tank is the basis for the determination of the unsafe condition. The method to determine flammability exposure time of a given fuel tank is provided in Element 4 and attachment 2 of this memo.

Current Regulatory and Advisory Material:

1. SFAR 88 latest amendment, effective 12/9/02
2. Sections 25.901, and 25.981 (a) and (b) as amended by Amendment 25-102
3. AC 25.981-1B or C (draft)

Definitions:

The following definitions only apply to this policy memorandum.

a) *Extremely Improbable*: An event is considered to be extremely improbable if it is so unlikely that it is not anticipated to occur during the entire operational life of all airplanes of one type. In quantitative terms, a failure or condition that can be anticipated to occur at a rate in the order of 10^{-9} events per flight hour or less. (Based on JAA ACJ 25.1309 & draft FAA AC 25.1309)

b) *Extremely Remote*: An event is considered to be extremely remote if it is unlikely to occur during the entire operational life of all airplanes of one type, but nevertheless has to be considered as being possible. In quantitative terms, a failure or condition that can be anticipated to occur at a rate between 10^{-7} and 10^{-9} events per flight hour. (Based on JAA ACJ 25.1309 & draft FAA AC 25.1309)

c) *Flammable*: Flammable with respect to a fluid or gas, means readily susceptible to ignition or to exploding. (14 CFR part 1, Definitions)

d) *Flammability Exposure Time*: The percent of operational time that the fuel tank ullage is flammable over the expected range of operational conditions during many different mission simulations. The simulations use the approved fuel types for the airplane model. It is calculated using the FAA Monte-Carlo method.

e) *Flammable fluid leakage zones:* Any area where flammable liquids or vapors are not intended to be present, but where they might exist due to leakage from flammable fluid carrying components (e.g. leakage from tanks, lines). Examples of these areas include:

- The wing leading (including any adjacent compartment such as the strut) and trailing edges,
- Farings located below the fuel tanks,
- Wheel wells,
- Fuel pump enclosures,
- Unpressurized areas of the fuselage surrounding fuel tanks, and
- Areas containing flammable fluid lines or tanks.

f) *Foreseeable*: An event or condition is foreseeable if the physics of the failure can be defined and the occurrence of the failure during the exposure period in question cannot be acceptably ruled out. The level of probability where an event is no longer considered “foreseeable” lies somewhere between "extremely improbable" and “impossible.” Any event that is “impossible” is clearly not “foreseeable.” All events that are not “extremely improbable” are considered “foreseeable.” However, for those events whose probability lie between “extremely improbable” and “impossible”, the determination as to whether or not they are to be considered “foreseeable” has less to do with their "probability" and more to do with the confidence we have in the provisions made to actively preclude their occurrence (e.g. design margins, quality assurance, conservative maintenance provisions, etc.). The bottom line is, if we don't have confidence the event will not occur, then it should be considered “foreseeable.”

g) *Hazardous Energy*: Energy into the fuel tanks greater than 200 micro-joules and surface temperatures in the fuel tank greater than 400 deg F.

h) *Known*: Those conditions which have occurred in-service and are likely to occur on other products of the same or similar type design, and conditions which have been subject to mandatory corrective actions, following in-service findings, on products with a similar design of fuel system.

i) *Low and High Flammability Exposure Time:* In determining whether a fuel tank is classified as either a tank with low or high flammability exposure time for the mission profile:

- Fuel tanks with low flammability exposure time are defined as those tanks that have a fleet average flammability exposure time no more than 7% using the FAA Monte-Carlo Model method.

- Fuel tanks with high flammability exposure time are those tanks that have a fleet Average Flammability exposure time of greater than 7% using the FAA Monte-Carlo Model method.

j) *Monte-Carlo Method*: The Monte-Carlo method was agreed to during both the 1998 and 2000 ARAC fuel tank harmonization working groups as the preferred method of analysis for determining flammability exposure time of a fuel tank. Monte-Carlo analysis is a simulation that calculates values for the parameter of interest by randomly selecting values for each of the uncertain variables from predetermined distribution tables. This calculation is conducted over and over to simulate a process where the variables are random within defined distributions. The results of a large number of calculations can be used to approximate the results of real world conditions. The Monte-Carlo Model should be run for at least 1,000 flights to generate a representative average percent flammability exposure time. The FAA approved model is available on FAA web site: http://qps.airweb.faa.gov/sfar88flamex

k) *Unheated Aluminum Wing Tank*: A conventional aluminum structure, integral tank of a subsonic transport wing, with minimum heat input from aircraft systems or other fuel tanks that are heated.

l) *Ullage or Ullage Space:* The volume within the tank not occupied by liquid fuel at the time interval under evaluation.

Policy:

SFAR 88 design reviews relative to the design standards of §§ 25.981 (a) and (b) and 25.901 may show that some fuel systems or components do not meet these design standards using AC 25.981-1 for guidance. The items identified by that review will be evaluated using the criteria herein to determine if an airworthiness directive is warranted. These criteria require identification of any unsafe conditions that would require corrective action regardless of tank flammability exposure time (e.g. single failures such as an electrical arc through a conduit). The criteria allow for flammability exposure time to be considered when evaluating the need for corrective action for certain combinations of failures. The applicant may choose to make a determination of high or low flammability exposure time using FAA approved methods, which are discussed in Element 4, and if they choose not to make a determination, the FAA will assume high flammability exposure time for their tanks. The method described in Element 4 includes an initial evaluation of tank cooling characteristics to determine if a tank is considered as high or low flammability exposure time. In general unheated wing tanks would be found to meet the low flammability exposure time criteria upon inspection. If the initial evaluation shows a tank does not meet the low flammability exposure time criteria, a further evaluation using the FAA Monte-Carlo analysis is required.

These criteria do not provide the entire basis for the decision on the actual implementation of mandatory corrective action (e.g. compliance time determination) on the aircraft type under consideration. Experienced engineering judgment is critical in determining assumptions, expected failure rates, and relationships between failures. The final decision will be made under the normal processes for issuing ADs (part 39) with the addition of a mandatory action advisory board whose function is to ensure standardization in the decision making process. A summary of the SFAR 88 AD

determination criteria is presented in the attached Table 1, "SFAR 88 Unsafe Condition Determination Criteria."

Four-Element Unsafe Condition Evaluation Criteria

Element 1. Single Failures – all tanks

For any tank (with a high or low flammability exposure time), any foreseeable single failure condition, regardless of probability and service experience, that may result in a potential ignition source within the fuel tank system is considered an unsafe condition and must be addressed by corrective action (i.e. AD).

In general, the FAA does not accept a probabilistic determination that a single failure be extremely improbable. However, experienced engineering judgment may enable an assessment that such a failure is not foreseeable. The assessment logic and rationale should be readily obvious that a knowledgeable, experienced person would unequivocally conclude that the failure condition simply would not occur. When making such an assessment, all possible and relevant considerations should be taken into account, including all relevant attributes of the design. Extensive service experience alone showing that the failure condition has not yet occurred is not sufficient reason to indicate that a single failure condition cannot exist.

Element 2. Combination of failures

a) Fuel tanks with low flammability exposure time
For fuel tanks with low flammability exposure time, known combinations of failures are considered an unsafe condition and must be addressed by corrective action (i.e. AD).

Known combinations of failures includes combinations of failures which have occurred in-service and are likely to occur on other products of similar type design (i.e. products with a similar design of the fuel system), and combinations of failures which have been subject to mandatory corrective actions, following in-service findings, on products with a similar fuel system designs.

b) Fuel tanks with high flammability exposure time
For fuel tanks with high flammability exposure time, non-compliant design features and associated maintenance actions identified by the system safety analysis that was conducted for the one time SFAR 88 design review will be used for establishing unsafe condition. These will be considered as unsafe conditions (i.e. strict compliance to §§ 25.981 (a) and (b) (Amendment 25-102) and 25.901 using guidance in AC 25.981-1 must be found) and must be addressed by corrective action (i.e. AD).

Element 3. Unacceptable service experience – all tanks

For any tank (either high or low flammability exposure time), all failures identified in service, that result in thermal or electrical energy dissipation into the fuel tank system which could create an ignition hazard, or making fuel tank safety protection devices inoperative (e.g. fuel pump canister, wire sleeving, bonding lead), are considered unsafe conditions and must be addressed by corrective action (i.e. AD). Those failures may result from equipment or component failures, aging, as well as

production or maintenance errors, and inappropriate flight deck actions (such as, leaving fuel pumps "ON" beyond their design usage).

Element 4. Determination of the flammability exposure time of each fuel tank

Typically, aluminum wing tanks without any heating source are considered to have a low flammability exposure time. However, several parameters including tank volume, geometry, amount of fuel remaining from the previous flight, ambient temperature, temperature of loaded fuel, time on the ground, may influence flammability exposure time. Determination of flammability exposure time of each fuel tank is required. In the absences of any substantiating analysis, all tanks shall be considered as a "high flammability exposure time" fuel tank. Table 2, "Flammability Exposure Time Determination," is attached at the end of this memorandum, which summarizes the following discussion on determining fuel tank flammability exposure time.

Acceptable method of analysis

In the absence of another method agreed to by the FAA, the following guidance is considered an acceptable means of establishing the flammability exposure time of each fuel tank. Other methods may be proposed, but shall be approved by the FAA. For the purpose of the assessment of in-service aircraft, this three-step approach has been harmonized between FAA and JAA.

Low Flammability Exposure Time Tank Determination:

Step 1.
Does the tank have characteristics of a Low Flammability Exposure Time tank, as defined below, by inspection and qualitative design review?

If Yes, tank is a Low Flammability Exposure Time Tank, if No, go to Step 2

Step 2.
Can the tank meet the abbreviated quantitative criteria for a Low Flammability Exposure Time Tank?

If Yes, Tank is a Low Flammability Exposure Time Tank, if No, go to Step 3

Step 3.
Can the tank meet the Low Flammability Exposure Time Tank Criteria using the FAA Monte-Carlo analysis and ground fuel temperature limit?

If Yes, Tank is a Low Flammability Exposure Time Tank, If No, Tank is a High Flammability Exposure Time Tank.

Characteristics of a Low Flammability Exposure Time Tank

For Step 1:
The qualitative design review criteria for a low flammability exposure time tank are:

1. During 4 hour operation on the ground on a 100 deg F day, a fuel temperature rise of less than 10 Deg F above ambient with an 80% full fuel load. Heat inputs to be addressed are any airplane based heat sources, both internal and external to the tank, including heat transfer from an adjacent tank that could heat the subject tank.

And

2. The ability of the tank to reject heat quickly to outside air. A conventional aluminum skin stringer construction, with a high percentage (80 to 90%) of the tank surface exposed to free stream air will satisfy this criterion.

For Step 2:

The abbreviated quantitative criteria for a low flammability exposure time tank are:

1. During 4 hour operation on the ground on a 100 deg F day, a fuel temperature rise of less than 10 Deg F above ambient with an 80% full fuel load. Heat inputs to be addressed are any airplane based heat sources, both internal and external to the tank, including heat transfer from an adjacent tank that could heat the subject tank.

And

2. Initial cruise fuel cooling rates of 20 Deg F per hour, with tank 80% Full, and 35 Deg F per hour with tank empty, starting from a fuel temperature of 60 Deg F, and TAT of –20 Deg F,

And

3. The fuel temperature at the end of a maximum range cruise shall be within 10 Deg F of TAT.

For Step 3:

The criteria for a low flammability exposure time tank are:

1. Has a Fleet Average Flammability exposure time of no more than 7% using the FAA Monte-Carlo Model method.

And

2. A fuel temperature rise of less than 20 Deg F on the ground starting with a 100 deg F ambient temperature and minimum operational fuel loaded in the tank, considering a ground operation period of at least four hours. Heat inputs to be addressed are any airplane based heat sources, both internal and external to the tank, including heat transfer from an adjacent tank anticipated to occur during the 4 hour period that could heat the subject tank.

Discussion

This approach would provide an evaluation of the thermal characteristics of the tank in question, and if it met the criteria above, the tank would be considered a low flammability exposure time tank. If a tank does not meet the above criteria it will be classified as a high flammability exposure time tank for the purpose of making unsafe condition findings. The Monte-Carlo model uses a flammability envelope that is based on a one joule spark, as being a relatively large spark, and in the lack of any real data on the distribution of spark sizes in a fuel tank, a conservative approach seemed appropriate. The model is an excel spreadsheet, and is downloadable from the FAA web site, http://qps.airweb.faa.gov/sfar88flamex . It is required to use version 5a or later of the Monte-Carlo model and provide documentation of how the

analysis was performed. See attachment 3 for guidance on how the documentation should be performed.

Flammability Reduction or Effects of Ignition Mitigating Devices
A suitable flammability reduction system such as inerting, or an ignition mitigating device such as foam, etc, may be used for ignition source mitigation. High flammability exposure time fuel tanks can be treated as low flammability exposure time fuel tanks for the purpose of SFAR 88 AD determination, if the mitigation of these devices is found acceptable by the Aircraft Certification Office (ACO) or office of the Transport Airplane Directorate having cognizance over the type certificate.

Systems & Areas Adjacent to the Fuel Tank
In general, the fire protection philosophy for any area considered a flammable fluid leakage zone is to assume that flammable vapors may be present in the zone and to minimize the probability of ignition of the vapors in accordance with § 25.863(a). This has typically been accomplished by using various standards of explosion-proof components and good design practices.

The existence of an unsafe condition should be determined based on the probability of a leak (taking into account in-service experience, and mitigating factors such as using double walls, protective coating, etc.), and considering the potential ignition sources and the design precautions taken in the area (component qualification, drainage, ventilation). Unsafe conditions must be addressed by corrective action (i.e. AD).

Maintenance Considerations
Results of safety assessments may define mandatory maintenance actions needed to prevent an unsafe conditions. These maintenance actions must be included in the limitation section of the instructions for continued airworthiness. Some manufacturers have developed airworthiness limitations (referred to as “Fuel System Limitations” by some manufactures) to differentiate these limitations from structural limitations. The limitations and critical design configuration control limitations (CDCCL) must be addressed in accordance with the standards of § 25.981(b) (Amendment 25-102) to ensure fuel tank system protective features are maintained and/or controlled.

Effect of Policy
The general policy stated in this document does not constitute a new regulation or create a new norm, but is for the purpose of clarifying the considerations for determining an unsafe condition using the findings from the one time fuel tank safety review conducted for SFAR 88. These criteria are intended to compliment the associated SFAR 88 advisory material and help determine which corrective action should or should not be introduced on in-service Airplanes. The office that implements policy should follow this policy when applicable to the specific SFAR 88 project. Whenever an applicant's proposed method of compliance is outside this established policy, it must be coordinated with the policy issuing office, e.g., through the issue paper process or equivalent.

Applicants should expect that the certification officials will consider this information when making determination of unsafe conditions for the fuel system design features

identified from the system safety analysis conducted for the one time SFAR 88 design review.

If you have further questions, the person on my staff most familiar with this issue is Mr. Dennis Kammers (425-227-2956).

/s/ Michael J Kaszycki
for Vi L. Lipski

cc: ANM-111, ANM-112, ANM-113, ANM-115, ANM-116, ANM-117

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Manager, Brussels Aircraft Certification Office, AEU-100
International Field Representative for Transport Directorate, AEU-102

TABLE 1
SFAR 88 Unsafe Condition Determination Criteria

	ELEMENT 4: Flammability Exposure Time		
	A **High Flammability Exposure Time tanks**	**B** **High Flammability Exposure Time tanks driven to Low Flammability Exposure Time tanks through inerting or other means**	**C** **Low Flammability Exposure Time tanks**
ELEMENT 1: Evaluation for Single Failures	**Unsafe if:** Foreseeable Single Failures Jeopardize Safe Operation **Required Action:** All identified single failure conditions must be addressed by corrective action (i.e. AD)		
ELEMENT 2: Evaluation for Combinations of Failures	**"Compliance"** **Unsafe if:** Any noncompliance to §§ 25.981 (a) or (b) (Amendment 25-102) or 25.901 using guidance in AC 25.981-1 **Required Action:** It is expected that any noncompliance finding will be considered as an unsafe conditions and addressed by corrective actions (i.e. AD)	**Unsafe if:** Known Combinations of Failures Jeopardize Safe Operation **Required Action:** All known combinations of failures must be addressed by corrective action (i.e. AD).	
ELEMENT 3: Evaluation for In-Service Experience	**Unsafe if:** In-service failures exist that either a) dissipate energy into tank/create ignition sources, or b) compromise fuel tank safety protection devices **Required Action:** All of the in-service failures must be addressed by corrective action (i.e. AD)		

Attachment 1

Table 2
Flammability Exposure Time Determination

Step 1 Can the tank satisfy the Low Flammability exposure time characteristics by qualitative inspection and design review? If Yes, tank is a Low Flammability exposure time tank, if No, go to Step 2 Step 2 Can the tank meet the Quantitative criteria for a Low Flammability exposure time tank? If Yes, Tank is a Low Flammability exposure time tank, if No, go to Step 3 Step 3 Can the tank meet the Low Flammability exposure time tank Criteria using the FAA Monte-Carlo analysis? If Yes, Tank is a Low Flammability exposure time Tank, If No, Tank is a High Flammability exposure time tank	**Characteristics of a Low Flammability Exposure Time Tank** Low Heat Input: Step 1: Qualitative Inspection &Design Review: No or very small airplane based heat sources (A fuel temp rise of less that 10 deg F above ambient on the ground, for a 100 deg F day with an 80% full fuel load) internal/external to the tank, including heat transfer from an adjacent tank that could heat the tank, and Ability to reject heat quickly to outside air. A conventional Aluminum skin stringer construction, high percentage (80 to 90%) of surfaces exposed to free stream air Step 2: Quantitative Determination: Less than 10 Deg F above ambient temperature rise on the ground over many hours with an 80% full fuel load, and Initial cruise cooling rates of 20 Deg F per hour, with tank 80% Full, and 35 Deg F per hour with tank empty, starting from 60 Deg F and a TAT of –20 Deg F, and End of long cruise tank temperature within 10 Deg F of TAT Step 3: Monte-Carlo Method: Has a Fleet Average Flammability exposure time of no greater than 7% using the FAA Monte-Carlo Model, and A fuel temperature rise of less than 20 deg F on the ground starting with a 100 deg F day

Attachment 2

Attachment 3

Documenting the Results of the Flammability Exposure Time Determination

This attachment provides guidance on how TC and STC holders should assemble documentation for flammability exposure time determination analysis, and when these results should be submitted.

Submittal Options

The results may be submitted to the FAA using any of the options shown below:

Option 1:
Submit the flammability exposure time determination results in a self contained document or report. The report should be submitted under appropriate cover letter to the FAA.

Option 2:
The results may be included as an added section of, or appendix to a revised copy of the document(s) originally submitted for compliance with SFAR 88. This new section should be clearly delineated from the other sections of the document. If this option is used, none of the original SFAR 88 non-compliance findings may be changed based on the fuel tank flammability exposure time. In other words, the flammability exposure time results **may not** be used to re-visit the original non-compliances and apply a risk/probability analysis to show compliance with § 25.981 (a) and (b) Amendment 25-102. The flammability exposure time results may only be used to determine if mandatory action is required for a given non-compliance. The revised report should be submitted under appropriate cover letter to the FAA.

Option 3:
The TC or STC holder may submit the results in any other reasonable, formally documented format. If this is the case, please ask them to contact the FAA and explain their proposed method of submittal.

Option 4:
The TC or STC holder may choose to not submit the results of a flammability exposure time determination analysis. In this case, for the purposes of determining mandatory actions, the FAA should assume the fuel tank is a high flammability exposure time fuel tank.

What to Include in the Documentation

The following should be included in the documentation of the flammability exposure time determination analysis.

1. A brief summary of the fuel tank configuration. This should include both a schematic of the fuel tank system, and diagrams and/or photographs showing the fuel tanks (external views). If this has already been done as part of the December 6, 2002 SFAR 88 document submittal, it is acceptable to refer to the appropriate section(s) of those documents.

2. The flammability exposure time determination method/step used, and the results for each fuel tank. These should be documented as follows:

If Step 1 is used:

What to include in documentation:

1. A brief description of the fuel tank, including
   - A qualitative description of all airplane heat sources into the tank, and heat sinks (areas drawing heat out of the tank).
   - A qualitative description of the fuel tank construction (i.e. aluminum skin/stringer construction)

2. For fuel tank stabilization temperatures, please provide the test data, or heat transfer analysis methods used to derive these
   - If test data is provided, a simple plot will suffice. There is no need to provide tabulated data. Include the source of the data, and brief details regarding the test conditions, and the configuration of the airplane (i.e. how closely did the test airplane fuel tanks match the production airplane.)
   - If test data is used, but a correction method is applied to emulate a particular ambient temperature (in the case of Step 1, 100 degrees F), please clearly indicate this. Also provide a detailed description of the method used to correct the test data to the equivalent of a 100 degree F ambient day.
   - If heat transfer methods will be used, please provide a suitable description of the methods used, including the development of the various inputs such as convective coefficients, and assumed heat rejection of any airplane based heat sources.

3. The Flammability Exposure Time Classification Statement: :
   - Example Statement: "Following the FAA-JAA Harmonized Fuel Tank Flammability Exposure Time Determination Methodology, (Company Name) has determined this fuel tank may be classified as a Low Flammability Exposure Time Fuel Tank."

4. Any other descriptive material, or data deemed appropriate

If Step 2 is used:

What to include in documentation:

Same as for Step #1

If Step 3 is used:

What to include in documentation

1. A brief description of the fuel tank, including:
    a. A qualitative description of all airplane heat sources into the tank, and heat sinks (areas drawing heat out of the tank).
    b. A qualitative description of the fuel tank construction (i.e. aluminum skin/stringer construction)

2. The printed "User Input" page from the Monte-Carlo spreadsheet, showing all input, and the analysis results.

3. For each input into the Monte-Carlo spreadsheet, a description of how that input was derived. An "input" is when any of the input fields are changed from their default values.

4. For fuel tank stabilization temperatures and time constants, please provide the test data, or heat transfer analysis methods used to derive these.
    - If test data is provided, a simple plot will suffice. There is no need to provide tabulated data. Include the source of the data, and brief details regarding the test conditions, and the configuration of the airplane (i.e. how closely did the test airplane fuel tanks match the production airplane.) The FAA will need to assess the integrity of this data, as applied to the development of input for the Monte-Carlo model.
    - If heat transfer methods will be used, please provide a suitable description of the methods used, including the development of the various inputs such as convective coefficients, and assumed heat rejection of any airplane based heat sources.

5. If anything in the Monte-Carlo spreadsheet was altered (other than the input fields in the input page), please do the following:
    a) Specify the baseline spreadsheet that was altered
    b) Provide a description of why it was changed, what was changed, and any supporting data/analysis used to develop the changes. (i.e. an alteration of the typical mission length profiles to closer match a specific model).
    c) Describe any testing/validation of the model after the changes were made

d) Please ensure that the file name, and the version description within the spreadsheet are changed from the baseline model. Include suitable notes and descriptive language in the input page, such that this spreadsheet cannot be mistaken for a baseline version.
e) Finally, please provide an electronic copy of the altered spreadsheet to the FAA.

6. The Flammability Exposure Time Classification Statement, as one of the two:
   - Example Statement: "Following the FAA-JAA Harmonized Fuel Tank Flammability Exposure Time Determination Methodology, (Company Name) has determined this fuel tank may be classified as a (Low/High) Flammability Exposure Time Fuel Tank."

7. Any other descriptive material, or data deemed appropriate

When to Submit The Flammability Exposure Time Determination Analysis

For Type Certificate Holders, the flammability exposure time determination analysis should be submitted to the FAA prior to or concurrent with the meeting of the mandatory action advisory board.

For Supplemental Type Certificate Holders whose STC involves auxiliary fuel tanks, the flammability exposure time determination analysis should be submitted to the FAA prior to or concurrent with the meeting of the mandatory action advisory board.